

New Jersey Department of Environmental Protection
Report on the Establishment of a
Total Maximum Daily Load for Fecal Coliform
and an Interim Total Phosphorus Reduction Plan
for the Whippany River Watershed

Executive Summary

Total Maximum Daily Loads (TMDLs) represent the assimilative or carrying capacity of the receiving water taking into consideration point and nonpoint sources of pollution, natural background, and surface water withdrawals. A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reductions for specific pollutants as necessary to meet surface water quality standards. TMDLs are required, under Section 303(d) of the federal Clean Water Act, to be developed for waterbodies that cannot meet surface water quality standards after the implementation of technology-based effluent limitations. TMDLs may also be established to help maintain or improve water quality in waters that are not impaired. A TMDL establishes Waste Load Allocations and Load Allocations for point and nonpoint sources, respectively. Regulations concerning TMDLs are contained in EPA's Water Quality Planning and Management Regulations (40 CFR 130). "A TMDL is established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." (40 CFR 130.7(c))

Where TMDLs are required to address documented surface water quality impairment, allocations are made to the varying sources contributing to the water quality problem in order to reduce the total pollutant load received by the waterbody. Load reduction goals established through TMDLs are achieved through the issuance of wasteload allocations for point source discharges and load allocations for nonpoint source discharges. Since nonpoint source pollution, by definition, does not come from discrete, identifiable sources, load allocations would consist of the identification of categories of nonpoint sources that contribute to the parameters of concern. The load allocation would also include specific load reduction measures for those categories of sources, to be implemented through best management practices (BMPs) including local ordinances for stormwater management and nonpoint source pollution control, headwaters protection practices, or other mechanisms for addressing the priority issues of concern.

In May 1999, the New Jersey Department of Environmental Protection (Department) and USEPA Region II entered into a Memorandum of Agreement including an 8-year schedule to produce TMDLs for all water quality limited segments remaining on the 1998 Section 303(d) List of Water Quality Limited Waterbodies in New Jersey or provide information necessary to remove waterbodies from the list (see Appendix C). This

TMDL for the Whippany River Watershed is the first to be developed by the Department under this MOA and are scheduled to be established by December 31, 1999. This report explains the process under which the TMDL for fecal coliform bacteria in the Whippany River Watershed was developed and what the TMDL will require once it is established. Notice of the TMDL has been published in the New Jersey Register as an amendment to the Northeast Water Quality Management Plan pursuant to N.J.A.C. 7:15-3.4. The TMDL will also be included in the Whippany River Watershed Management Plan when it is published in early 2000. The purpose of the Whippany River Watershed Management Plan is to advance measurable goals, objectives and strategies to restore, enhance and protect the Whippany River Watershed so that it can be maintained as a viable and valuable resource for present and future generations.

Background Information

The TMDL for fecal coliform was developed as part of the Whippany River Watershed Project. The Whippany River Watershed Project was a pilot effort initiated in October 1993 to aid the Department in developing a comprehensive watershed management process that could be replicated throughout the state. An extensive technical effort has grown out of this project intended to identify, prioritize and analyze water quality in the Whippany River Watershed and to provide an understanding of the cause and effect relationships associated with all significant pollution sources, both point and nonpoint. The TMDL analysis represents a significant portion of this technical effort.

There has been significant public involvement in the Whippany River Watershed Project, formalized through the creation of the Whippany Watershed Partnership in 1994. The Whippany Watershed Partnership is comprised of approximately 120 representatives of local, county, regional, state and federal government agencies; local and regional businesses and industries; academia; environmental and civic groups; and area residents. The Whippany Watershed Partnership includes a Public Advisory Group (PAG) and several committees that have been working with the Department on different aspects of the Whippany River Watershed Project, including the development of the TMDL methodology. The mission of the Whippany Watershed Partnership is to regain the value of the Whippany River as a vital natural resource through the proper management of the Whippany River Watershed. Proper management means consideration of the entire watershed, including current and future water resources, and the interrelationships between: surface and ground waters, water quality and quantity (e.g. water supply, flooding, etc.), and water and land resources and their uses. Proper management also means consideration of the need to sustain communities and their beneficial growth and improvement while meeting mutually agreed upon environmental protection objectives. These objectives were collaboratively developed through the watershed management planning process and will be achieved through implementation of the Whippany River Watershed Management Plan.

The vision for the Whippany River Watershed is to continue the restoration of the Whippany River and manage its watershed so that we can once again have a viable natural resource that is valued for the many environmental, economic and aesthetic benefits it provides, including: diverse and abundant populations of fish, wildlife, aquatic habitat; clean and available water supplies; recreational opportunities and access; environmentally-responsible economic activity and environmentally compatible infrastructure. In order to realize this vision, the Whippany PAG formed several committees to focus on specific aspects of the watershed and the watershed planning process. A Technical Advisory Committee was formed to work with the Department to identify water quality issues of concern and develop a methodology for monitoring, modeling and assessment to evaluate the root cause of any verified water quality problems. The water quality assessment process began with a review and screening of

the historical data for several parameters of concern, including but not limited to those identified as causes for impairment on the 303(d) List. Specific consideration was given to the limitations inherent in heavy metals data collected before “clean” sampling methods had been developed.

Surface Water Quality Standards

The Surface Water Quality Standards (N.J.A.C. 7:9B et seq.) apply to all waters of the State of New Jersey. Classifications and criteria for selected parameters that apply to the Whippany River are presented below.

Surface Water Classifications¹ within the Whippany River Watershed

Whippany River	
<i>(Brookside) – Source to Whitehead Road Bridge</i>	<i>FW2-TP(C1)</i>
<i>(Morristown) – Whitehead Road Bridge to Rockaway River</i>	<i>FW2-NT</i>
Whippany River Tributaries	
<i>(Brookside) – Entire length</i>	<i>FW2-TP(C1)</i>
<i>(East of Brookside) – Entire length</i>	<i>FW2-TM</i>
<i>(East of Washington Valley) – Entire length</i>	<i>FW2-TM</i>
<i>(Gillespie Hill) – Entire length</i>	<i>FW2-TP(C1)</i>
<i>(Shongum Mountain) – Entire length</i>	<i>FW2-NT</i>

Surface Water Quality Criteria

Surface Water Quality Criteria are found in the New Jersey Surface Water Quality Standards at N.J.A.C. 7:9B et seq. and are summarized below for the three major classes of pollutants.

Eutrophication Parameters

Eutrophication is the acceleration of the natural aging process that normally occurs in lakes over geologic time frames. Excessive primary production coupled with excessive sedimentation are the key processes involved in eutrophication. The undesirable effects of eutrophication include siltation and alteration of dissolved oxygen dynamics. Eutrophication is addressed in the surface water quality standards with the following criteria.

¹ “FW2” means those waters that are not “FW1” or Pinelands Waters
“TP” means trout production
“TM” means trout maintenance
“C1” means Category One waters
“NT” means non-trout

1. Total Phosphorus Criteria, N.J.A.C. 7:9B-1.14(c)5

For FW2 lakes, ponds, reservoirs, or tributaries at the point where it enters such bodies of water, total phosphorus shall not exceed 0.05 mg/L.

For FW2 streams: Total Phosphorus shall not exceed 0.10 mg/L unless it can be demonstrated that phosphorus is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

2. The Surface Water Quality Standards Nutrient Policy #2, N.J.A.C. 7:9B-1.5(g)2

Nutrient Policy #2 is a narrative criterion that reads:

Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, or otherwise render the waters unsuitable for the designated uses.

3. The Surface Water Quality Standards Nutrient Policy #3, N.J.A.C. 7:9B- 1.5(g)3

Nutrient Policy #3 allows the Department to establish site-specific water quality criteria for nutrients that supercede the above generic criteria.

4. Dissolved Oxygen Criteria, N.J.A.C. 7:9B-1.14(c)2

For FW2-TP: not less than 7.0 mg/L at any time.

For FW2-TM: 24 hour average not less than 6.0 mg/L, but not less than 5.0 mg/L at any time.

For FW2-NT: 24 hour average not less than 5.0 mg/L, but not less than 4.0 mg/L at any time.

For FW2-TM and FW2-NT, supersaturated dissolved oxygen values shall be expressed as their corresponding 100 percent saturation values for purposes of calculating 24 hour averages.

Pathogen Indicators

Because pathogens (disease-causing organisms) present in surface waters are few in number and difficult to isolate, groups of more common bacterial species, commonly found in association with pathogens, are used as indicators of possible pathogenic contamination. Two groups of bacteria are currently included in the Surface Water Quality Standards as pathogen indicators: fecal coliforms and enterococci. Fecal coliform data have historically been used to determine impairment due to pathogenic contamination.

Fecal Coliform, N.J.A.C. 7:9B-1.14(c)1.ii

For FW2 Classifications: levels shall not exceed a geometric average of 200 counts per 100 ml, nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 counts per 100 ml.

Toxics

Surface water quality criteria for toxics are listed individually in 7:9B-1.14(c). Criteria for toxic constituents of concern in the Whippany River Watershed are listed below.

Metals, N.J.A.C. 7:9B-1.14(c)13

arsenic – 0.0170µg/L total recoverable for all FW2

beryllium – no applicable criteria

cadmium – 1.0 µg/L dissolved for all FW2 (EPA standard applies), depending on hardness

chromium

trivalent - 180 µg/L dissolved for all FW2 (EPA standard applies), depending on hardness

hexavalent - 10 µg/L dissolved for all FW2 (EPA standard applies)

copper –11 µg/L dissolved for all FW2 (EPA standard applies)

lead – 2.5 µg/L dissolved for all FW2 (EPA standard applies), depending on hardness

mercury – 0.012 µg/L dissolved for all FW2 (EPA standard applies)

zinc - 100 µg/L dissolved for all FW2 (EPA standard applies), depending on hardness

Un-ionized Ammonia

For FW2-TP and FW2-TM: 20µg/L 24 hr. average

For FW2-NT: 50µg/L 24 hr. average

303(d) Listed Parameters

In accordance with the Federal Clean Water Act, the Department prepared New Jersey's 1998 list of water quality limited waterbodies. This list is required by section 303(d)(1)(A) of the Federal Clean Water Act and is a component of the Statewide Water Quality Management Plan, as required by the Water Quality Management Planning Rules at NJAC 7:15-2.1(a)8ii and 7:15-6. Section 303(d) of the Federal Clean Water Act requires New Jersey to identify waters that are not attaining or not expected to attain water quality standards after the implementation of technology based effluent limits. New Jersey must prioritize these water quality limited waterbodies for TMDL analyses that are planned within the next two years.

New Jersey's 303(d) List divides water quality characteristics for waters in the State of New Jersey into two categories. Part 1 lists waters where impairments of water quality are known or where exceedances are based on conventional pollutants (except for ammonia) and fecal coliform, fish and shell fish consumption advisories, and other exceedances of numerical criteria compiled through monitoring subjected to QA/QC procedures developed after 1994. Part 2 represents waters with evidence of water quality concerns but without sufficient information to characterize the waterbody as a "known water quality limited segment." Such waters either lack extensive data or the existing data indicates that further analysis is warranted. Heavy metals and ammonia fall into this "suspected" category. All chemicals suspected of causing water quality impairment undergo supplemental monitoring to confirm impairment and to develop appropriate management responses.

Below is a summary of the 1998 Section 303(d) Known Water Quality Impairment listings for the Whippany River (Part 1).

Waterbody Name	Reach #/Location	Pollutant/Impact: Water Quality Violation
Whippany River	02030103-024-020 Morristown	fecal coliform total phosphorus
Whippany River	02030103-024-020 near Pine Brook	dissolved oxygen fecal coliform total phosphorus

Below is a summary of the 1998 Section 303(d) Suspected Water Quality Impairment listings in the Whippany River (Part 2).

Waterbody Name	Reach #/Location	Pollutant/Impact: Water Quality Violation
Whippany River	02030103-024-020 near Pine Brook	ammonia, arsenic ⁴ , beryllium ^{2,4} , cadmium ^{2,4} , chromium ² , copper ⁴ , lead ⁴ , zinc ^{3,4}

² Metal was proposed for delisting with respect to human health criteria for total recoverable metals in the 1998 Impaired Waterbodies List. The delisting will be reflected in the 2000 Impaired Waterbodies List.

³ Metal was proposed for delisting with respect to aquatic life criteria for dissolved metals in the 1998 Impaired Waterbodies List. The delisting will be reflected in the 2000 Impaired Waterbodies List.

Whippany River	02030103-024	arsenic, beryllium ² , cadmium ² , chromium ^{2,3} , copper, lead, mercury, zinc ³
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⁴ Metal was inadvertently omitted from listing tables, but is listed as discussed in text (pages 15-17 and 25), in 1998 Impaired Waterbodies List. The table above includes these corrections.

Response to the 1998 303(d) List for the Whippany River

Suspected Water Quality Impairments

Analysis of Ambient Data

The original basis for listing the Whippany River on the 303(d) List was water quality violations observed in data collected in the early to mid 1980's from the Morristown and Pine Brook monitoring sites which was reviewed in the late 1980's for the State's 304(l) list. Many historical discharges are now no longer present and many discharges, while remaining, have undergone significant upgrades to their treatment systems. In order for the Department to assess current conditions, several recent reviews were undertaken of in-stream data collected at the Morristown and Pine Brook sites. An initial review of historical data was performed in 1994 for the Whippany Pilot Project in order to delineate pollutants of concern for the Project. A subsequent review to satisfy requirements specifically under 303(d) followed in 1997. The adopted de-listings in the 1998 303(d) list for beryllium, zinc, cadmium (for human health) and chromium in the current 303(d) List were based upon this second 303(d)-specific review.

In 1995, stream monitoring was performed in selected locations of the Whippany River according to a sediment screening methodology developed in 1994 to target metals monitoring. Metals were analyzed using Clean Methods⁵ for copper, lead and cadmium. Results of this monitoring showed that these metals were below levels formerly indicated by previous traditional sampling. It is expected that the continued 303(d) listing of lead, copper, and chromium for violations of acute aquatic life criteria and for human health (lead) will only be temporary, pending the additional sampling necessary to satisfy the new protocols for delisting, currently being developed between USEPA Region II and the Department.

Department Response

Below is a summary of the responses the Department discussed in the 303(d) List for those toxics remaining on the list.

Ammonia: Municipal discharge data indicate a declining input of ammonia statewide and in the Whippany River. The Department is pursuing delisting ammonia for the Year 2000 303(d) List.

⁵ Clean Methods refers to the newer metals sampling protocols that greatly reduce the contamination and consequent false positives associated with historical metals data.

Arsenic: The current level of detection is 1.0 µg/L and the surface water quality criterion is 0.017 µg/L for human health as total recoverable. Due to low human health criterion in relation to the current minimum detection limit, laboratory procedures employing lower detection limits must be employed to reassess this metal statewide.

Beryllium: The Department is proposing to delist beryllium statewide, since there are no applicable surface water quality criteria associated with these elements. Results will be incorporated into the Year 2000 303(d) List.

Cadmium: The calculated aquatic life criterion of 1.1 µg/L is similar in value to the level of detection for cadmium of 1.0 µg/L. Therefore, this element will continue to be listed until such time as alternative analyses using lower detection limits can be applied.

Chromium: Review of the record (1990-1997) shows no violations as total recoverable using the human health criterion of 160 µg/L at the Morristown and Pine Brook stations. Total recoverable serves as a screening surrogate for the dissolved form using the aquatic life chronic criterion. In assessing the aquatic life support, the criteria for the hexavalent form is the most restrictive; the criteria are 15 µg/L and 10 µg/L for acute and chronic exposure respectively. No values as total recoverable chromium (sum of all valence states) exceed 2.0 µg/L at Morristown; however, one sample was 14 µg/L during the period of review at the site near Pine Brook. Therefore, the Department will conduct further analysis of the hexavalent state near Pine Brook.

Copper: Preliminary sampling in the Whippany River using clean methods and analyzing filtered samples indicate that copper levels are elevated. Therefore, additional monitoring is warranted to confirm concentration level for this element.

Lead: Preliminary sampling in the Whippany River using clean methods and analyzing filtered samples indicate that lead levels are elevated. Therefore, additional monitoring is warranted to confirm concentration level for this element.

Mercury: The current level of detection is 0.1 µg/L and the surface water quality criterion is 0.012 µg/L for chronic aquatic life. Due to low criterion in relation to the current minimum detection limit, laboratory procedures employing lower detection limits must be employed to reassess this metal statewide.

Zinc: Review of the record (1990-1997) at both Morristown and Pine Brook show no violation of the calculated aquatic life criteria of 49 and 42 µg/L, respectively, using total recoverable as a screening surrogate for dissolved. Therefore, the Department is pursuing delisting zinc at both locations for the Year 2000 303(d) List.

Resampling of the Whippany River and other sites within WMAs 3, 4, and 6 for metals as indicated above remains a very high Departmental priority. Low flow conditions are required to conduct this monitoring, and these have not occurred since before Hurricane

Floyd in September 1999. Since metal monitoring results to date have not confirmed any water quality impairments, TMDLs for metals are not warranted at this time.

Known Water Quality Impairments

The Department is required to establish TMDLs for any parameters identified as causing a water quality impairment to the Whippany River, pursuant to the TMDL MOA and the 1998 Section 303(d) list. These parameters were identified in the 1998 303(d) List as: dissolved oxygen, fecal coliform and total phosphorus. The Department is proposing a targeted response to address each of these parameters that includes: delisting for dissolved oxygen, demonstrating that the Whippany River is in compliance with the Surface Water Quality Standards with respect to total phosphorus, and a TMDL for fecal coliform.

Dissolved Oxygen

The *1996 Statewide Water Quality Inventory Report for New Jersey* (the 305(b) Report) states that the Whippany River did not exceed surface water quality criteria for dissolved oxygen at Morristown and Pine Brook. These stations are monitored 5 times per year and the 305(b) report analysis was based on data collected between 1990 and 1994. Data collected from 1995 through October 1997 at Morristown and Pine Brook also showed no exceedences of dissolved oxygen criterion. Improving trends in dissolved oxygen concentration from 1973 to 1995 supports these findings. The 1996 305(b) report states:

Comparisons of dissolved oxygen (DO) levels between 1973 and 1995 indicate that DO increased significantly between 1973 and 1980, and then again from 1980 to 1995. These are believed to be the results of substantial upgrades to the wastewater treatment systems that have occurred within the watershed and the corresponding substantial reduction in the discharge of oxygen demanding materials. These reductions are reflected in reduction in in-stream biological oxygen demand (BOD) of some 80% in twenty years in the Whippany River.⁶

Dissolved oxygen data, including diurnal samples taken in 1994 and 1995 from the Whippany River Mainstem, indicate that dissolved oxygen remains above the 24-hour average standard of 5.0 mg/L. These data support delisting at these locations, which will be pursued during the development of the Impaired Waterbodies List for 2000.

⁶ page 69 of the 305(b) report

Total Phosphorus

According to the Surface Water Quality Standards Nutrient Policy #2 (N.J.A.C. 7:9B-1.5(g) 2): "...except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, or otherwise render the waters unsuitable for the designated uses." Under N.J.A.C. 7:9B-1.14(c) 5, " ... Total Phosphorus [in an FW2 stream] shall not exceed 0.10 mg/L unless it can be demonstrated that *phosphorus is not a limiting nutrient* and will not otherwise render the waters unsuitable for the designated uses." (emphasis added)

The 1998 303(d) List identifies the Whippany River as impaired for Total Phosphorus because in-stream concentrations in some locations exceed 0.1 mg/l. Since the Department has determined that phosphorus is neither limiting primary production nor causing impairment of designated uses in the Whippany River,⁷ the numerical Total Phosphorus criterion does not apply in the Whippany River. In addition, since there is no evidence of objectionable algal densities or nuisance aquatic vegetation in the Whippany River, there is no violation of the Nutrient Policy. Therefore, a TMDL for Total Phosphorus is not required at this time because the Whippany River is in compliance with the Surface Water Quality Standards with respect to phosphorus.

Despite the fact that the numerical phosphorus criterion does not apply in the Whippany River and the Whippany River is in compliance with the Surface Water Quality Standards with respect to phosphorus, the Department is not pursuing the removal of Total Phosphorus from the 303(d) List for the following reason. The Whippany River is a tributary to the larger Passaic River Basin, wherein phosphorus is known to contribute to the impairment of designated uses as evidenced by documented excesses in algal growth. The TMDL for Total Phosphorus in the Passaic River is scheduled for completion by June 30, 2002.⁸ It is expected that phosphorus controls may be required in the Whippany River and other tributaries to the Passaic River, as well as within the mainstem, as part of the TMDL for Total Phosphorus in the Passaic River in 2002. However, the extent and nature of those controls is not known at this time and can only be determined through the TMDL process. At this time, the Department is implementing interim phosphorus restrictions (described below) on municipal dischargers within the Whippany River Watershed, limiting their discharge to existing effluent quality. This restriction will serve to minimize further phosphorus discharges to the Passaic River while the TMDL is being developed. In addition, the implementation of the TMDL for fecal coliform in the Whippany River Watershed will provide a residual reduction in

⁷ Appendix E. *Determination that phosphorus is neither limiting primary production nor causing impairment of uses in the Whippany River*

⁸ Appendix C. Memorandum of Agreement between U.S. EPA Region II and NJDEP. *Schedule to Establish Total Maximum Daily Loads for all Waterbodies Listed 1 in the State of New Jersey's 1998 303(d) List*. Signed May 1999.

phosphorus contributions from nonpoint sources of bacterial pollution that also contribute phosphorus.

The Passaic River TMDL process will address pollutants of concern including, at a minimum, dissolved oxygen, nutrients and pollutant parameters contributing to eutrophication. Significant point and nonpoint sources of phosphorus in the Whippany River may be affected by the outcome of the Passaic River TMDL development process. The Passaic River TMDL will be developed in collaboration with watershed partners in Watershed Management Area (WMA) 3 (Pompton, Pequannock, Wanaque and Ramapo River Watersheds), WMA 4 (Lower Passaic and Saddle River Watersheds) and WMA 6 (Whippany, Rockaway, Upper and Mid-Passaic River Watersheds). A Public Advisory Committee and a Technical Advisory Committee for WMA 6 has already been formed and is currently working with the Department to develop a Watershed Characterization and Assessment Report. Stakeholders from WMAs 3 and 4 will also be included in the development of the Passaic River TMDL.

Interim Total Phosphorus Reduction Plan

While the Whippany River is in compliance with the Surface Water Quality Standards with respect to phosphorus and no impairment of the River's designated uses are caused by excessive primary production, there is no doubt that excessive phosphorus levels further downstream are causing adverse impacts to the Passaic River. It is not known how much, if any, total phosphorus from the Whippany River is contributing to downstream total phosphorus levels. However, there is agreement among the Whippany Watershed Partnership that existing effluent quality should be maintained and any feasible short-term reductions in phosphorus levels should be pursued prior to the development of a phosphorus TMDL for the Passaic River in order to reduce or prevent further increases in phosphorus concentrations. This Interim Total Phosphorus Reduction Plan, developed from the recommendations of the Whippany River Watershed Technical Advisory Committee, is being implemented as an interim response to phosphorus reduction before the Passaic River TMDL is developed.

This Interim Total Phosphorus Reduction Plan requires that between the adoption of this Plan and the adoption of the Passaic River TMDL, municipal point source dischargers within the Whippany River will investigate and implement appropriate low cost methods to reduce phosphorus effluent loading. The goal of these interim measures is to achieve a net reduction of phosphorus loading from the permittees before the Passaic River TMDL has been developed. Furthermore, the Department will revise NJPDES permits based on a calculation of existing effluent quality and applicable low-cost improvement measures.

The permittees shall explore the low cost phosphorus reduction methods attached as Appendix D and provide a report to the Department within 6 months of the adoption date of this Interim Total Phosphorus Reduction Plan addressing the applicability of each method to permittees' treatment facilities. Appendix D is not an exclusive list, and

permittees are encouraged to identify additional low cost phosphorus reduction methods. For each identified applicable method, the permittee shall immediately commence implementation and provide an implementation schedule as part of the report. If a permittee has previously identified and implemented low cost phosphorus reduction methods, the report shall identify the method(s), the date(s) of implementation, and the effectiveness of the method in reducing phosphorus loading. The Department shall determine and notify the permittees within 45 days of receipt whether the reporting requirement has been satisfied. In the event the Department determines the report to be deficient, the notice shall specify any deficiencies which must be addressed.

Pursuant to N.J.A.C. 7:14A – 16 et seq., the Department shall issue draft major modifications or draft permit renewals to the affected municipal NJPDES dischargers in the Whippany River (Appendix A) as expeditiously as possible but not later than one year after adoption of this plan. Such modifications or renewals will include total phosphorus effluent limitations based on existing effluent quality calculated in accordance with N.J.A.C. 7:14A – 13.8 (Appendix B) as well as implementation of low cost phosphorus reduction methods. The effluent limit shall be for a concentration expressed as a monthly average on a seasonal basis. The winter season shall be deemed to be November through April, and the summer season shall be deemed to be May through October. The permit modification or permit renewal shall include a phosphorus influent-monitoring requirement based on the phosphorus effluent monitoring frequency. These permit modifications affect only municipal dischargers since they comprise the vast majority of phosphorus point source load to the Whippany River.

Permittees may petition the Department to modify the existing effluent quality phosphorus effluent limitation established by the above to reflect an increase of influent phosphorus due to phosphorus-based corrosion control measures by a supplier of water. The Petition shall address: the water suppliers dosing practices, variation of phosphorus concentrations within the water supply distribution system, relationship of the water supply within the permittees service area (by percentage of permittees total flow), changes in industrial contributions, status and effectiveness of implemented low cost phosphorus reduction methods, and a demonstration of relationship between influent phosphorus and effluent phosphorus monitoring data.

In the event that a permittee either physically expands its facilities prior to the adoption of TMDL-based Wasteload Allocations for the Passaic River to accommodate additional influent or incurs capital costs greater than 25% of the present value of the facility to upgrade or replace portions of the existing treatment facility, the NJPDES permit shall be modified to include a phosphorus effluent limitation of 1.0 mg/L as a monthly average. In the event a permittee requests a flow re-rating which does not require expansion or upgrades of any kind to the existing treatment facility, the permit modification, if granted, shall include a monthly average loading limit for phosphorus based on the flow value prior to the re-rated flow value and the concentration value

established pursuant to the above. The interim phosphorus limit shall remain in effect until establishment of the Passaic River Basin TMDL, at which time the NJPDES permits shall be modified to incorporate effluent limitations based on adopted Wasteload Allocations and, if appropriate, provide a schedule of compliance.

Recently, eight municipal NJPDES dischargers in the Passaic River Basin signed a stipulation of settlement, which is similar in nature and content to this described interim total phosphorus reduction plan. The Hanover STP mentioned in this report is party to that settlement.

Most of the short-term measures designed to mitigate fecal nonpoint source loading (see below) will also achieve an accompanying reduction in phosphorus. The Whippany River Watershed Nonpoint Source Pollution Control Guidance Manual prepared by the Whippany NPS Workgroup will serve as a general guide to local officials in selecting appropriate BMPs that best address nonpoint source pollutants of concern in their municipality or subwatershed. The guide will help the user through selecting specific source control measures that are pollutant specific as well as site specific.

Fecal Coliform

As stated previously, the Surface Water Criteria for fecal coliform is at N.J.A.C. 7:9B-1.14(c)1.ii

For FW2 Classifications: levels shall not exceed a geometric average of 200 counts per 100 ml, nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 counts per 100 ml.

Sources

Fecal coliform is a group of bacteria used as an indication of the potential presence of pathogens (diseased causing organisms) of fecal origin. The sources of fecal coliform contamination have been narrowed down from a myriad of potential fecal nonpoint source pollutant sources. Source identification was determined from:

Evaluation of water quality data from the nonpoint source monitoring conducted in the Whippany River Watershed in 1996 and 1997⁹ indicates high levels of fecal coliform at specific locations in the Watershed. These locations are indicative of certain land uses.

⁹ Killam Associates. August 1997. *Whippany River Watershed Project, Storm Event Water Quality and Streamflow Data*. Storm #1: November 8-9, 1996; Storm #2: April 12, 1997; Storm #2a: July 9, 1997.

Killam Associates. October 1998. *Whippany River Watershed Project, Storm Event Water Quality and Streamflow Data*. Storm #3: June 12, 1998.

For example, the table below is a summary of the fecal coliform monitoring from November 9, 1996:

Station ID	Land Use	Range fecal coliform
LS-1 (AA)	Forest Land Cover	55 – 2,800
LS-2 (BB)	Mixed Land Use	7,600-21,000
LS-3 (CC)	Industrial	11,000 – 61,000
LS-4 (DD)	Low Density Residential	5,000 – 92,000
LS-5 (EE)	Wetlands Runoff	210 – 390

In addition, prior studies of a bathing beach in Mendham Township by local health officials indicated that septic systems might be the contributing factor to fecal coliform impairment during a storm event. Canada geese and associated fecal matter was observed visually by health officials at the Mendham Township bathing beach as well as at a Lake Parsippany bathing beach. The Department in collaboration with the Whippany NPS Workgroup and the Technical Advisory Committee narrowed down the scope of the primary sources of fecal contamination to:

Human Sources of Fecal Coliform:

- Malfunctioning or older improperly sized septic systems in the upper portion of the Whippany River Watershed

Non-Human Sources of Fecal Coliform:

- Canada geese, waterfowl and other wildlife
- Pet waste
- Stormwater basins which can act as accumulation points of fecal matter (from pets, waterfowl and wildlife)

Loading Capacity

The Whippany River Watershed Model was developed by the Department in collaboration with the Technical Advisory Committee and the Modeling Subcommittee. Water quality scientists on the TAC provided peer review throughout the development of the model and acceptance of the final product. The model integrates a landside runoff model with a spatially explicit receiving water model into a novel code, the theory for

which is presented in Appendix F. Intensive steady-state monitoring events¹⁰ were performed on three different occasions in 17 locations throughout the watershed to provide data for calibration and verification of the receiving water model. In addition, wet weather data were collected during three different storm events in 5 sub-watersheds and two in-stream locations to provide data for calibration and verification of the landside model. The landside model was calibrated successfully in four sub-watersheds for fecal coliform.

Fecal coliform concentrations were estimated by applying model coefficients determined from calibration and verification of individual sub-watersheds¹¹ to the Whippany River Watershed Model. Figure 1 shows the current condition in terms of daily fecal coliform concentrations and 30-day geometric mean concentrations simulated over one year. The applicable 30-day geometric mean criterion of 200 counts/100ml is also shown for comparison. The dry weather base concentration is about 225 most probable number (MPN) MPN/100ml, but storm events throughout the year drive the 30-day geometric mean considerably higher. Figure 2 estimates the annual loading profile of point and nonpoint sources, with nonpoint sources being broken down by land use. Point sources contribute a negligible portion of the annual load and in fact provide dilution of fecal coliform.

¹⁰ NJDEP. *Steady state high and low flow water quality data*. Oct. 4-6, 1994, April 26-28, 1995, and Sept. 5-7, 1995. Whippany River Watershed Project.

¹¹ Omni Environmental Corporation. July 1999. *Whippany River Watershed Project, Stormwater Model Calibration and Verification Report*.

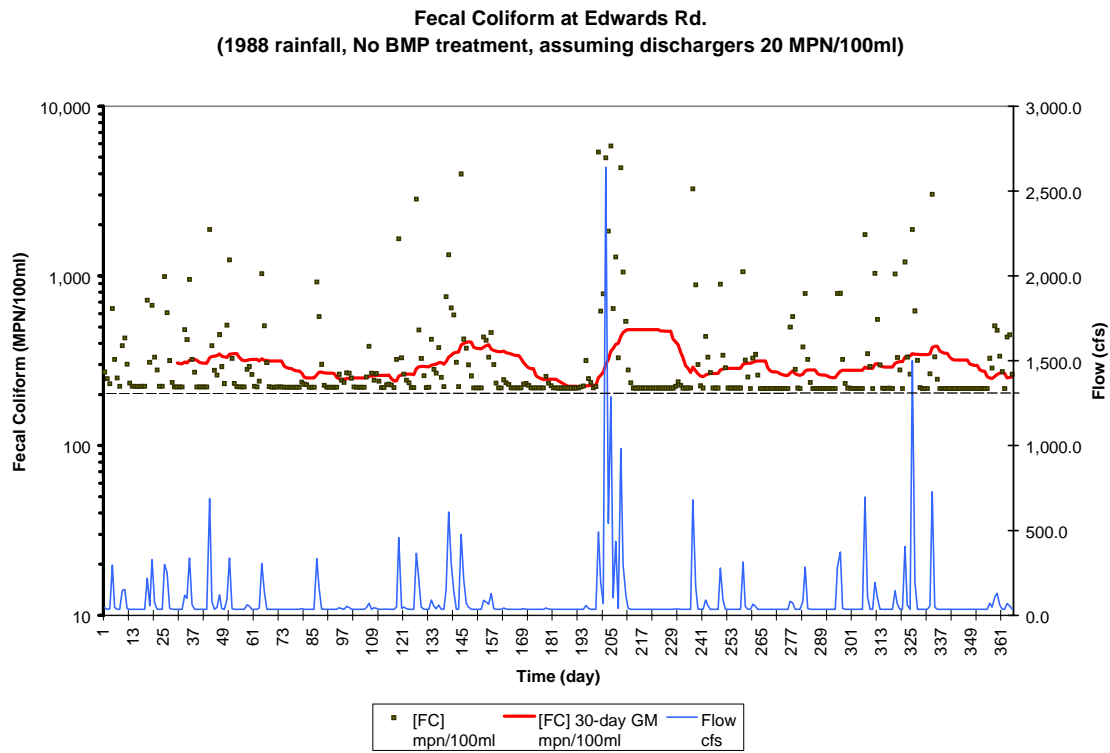


Figure 1 Model simulation of current condition

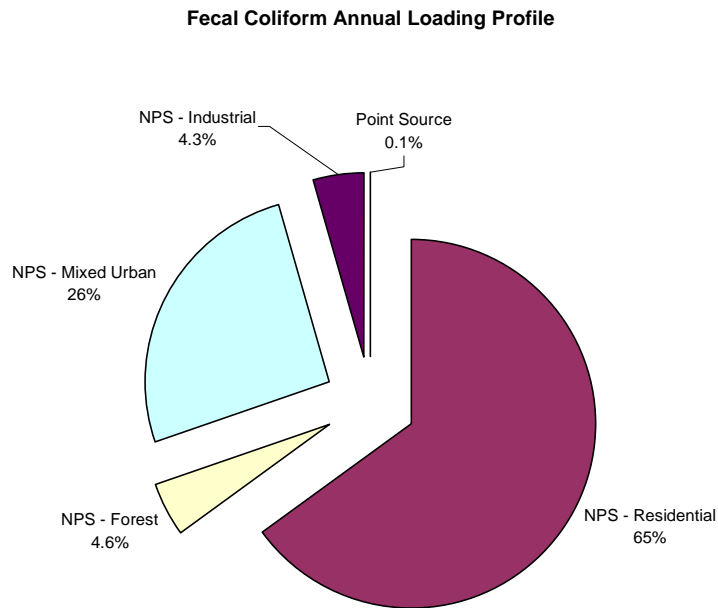


Figure 2 Model estimation of Point to Nonpoint Source Loading Profile

The target condition was determined by reducing nonpoint source loading rate such that the maximum 30-day geometric mean was set equal to the 200 MPN/100ml criterion (Figure 3). A 58.5% reduction on overall nonpoint source loads was necessary to achieve the simulated target condition. Notice that the base dry weather concentration in the target condition reduces to less than half the geometric mean criterion. Over the duration of the one-year simulation, only 6.3% of the daily concentrations were higher than 400 MPN/100ml.

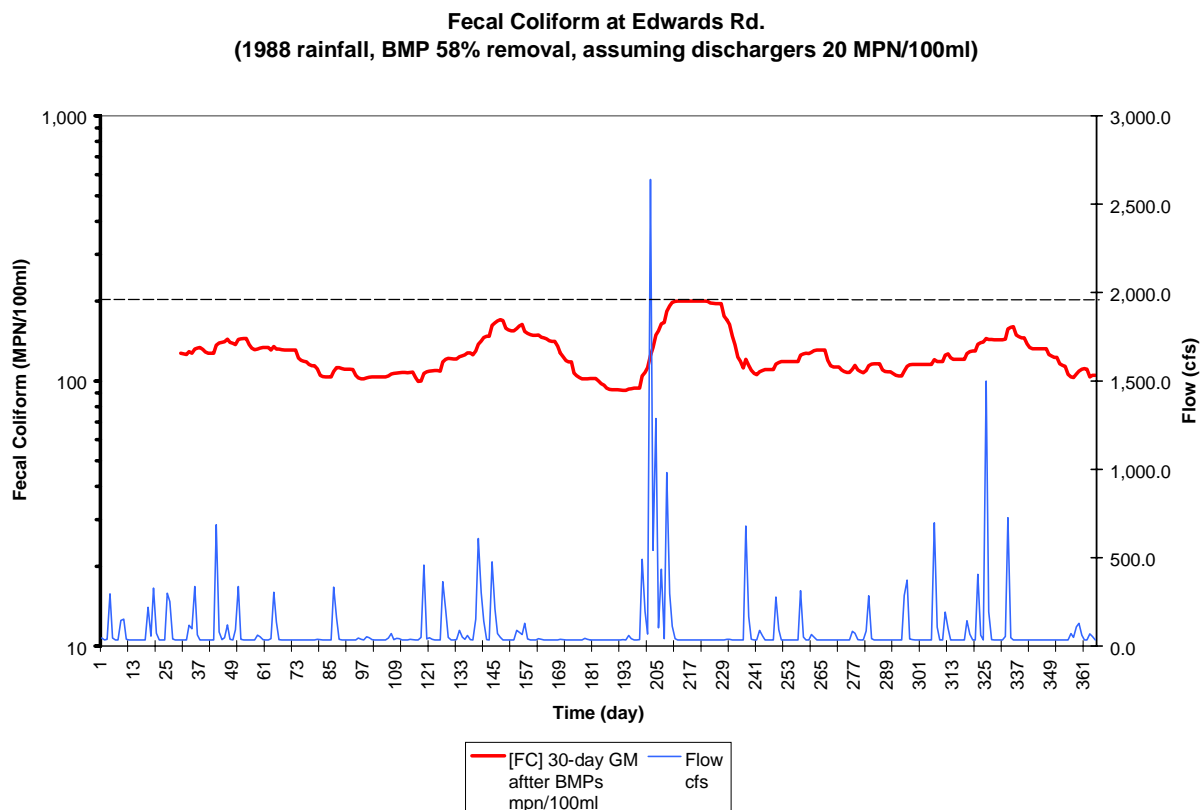


Figure 3 Model simulation of target condition

TMDL Calculation

Annual loads were estimated by summing up the daily loads over a one-year simulation. In order to comply with the 200 MPN/100ml 30-day geometric mean criterion for fecal coliform, the TMDL for the Whippany River Watershed is established as follows:

$$\begin{aligned} \text{TMDL} &= 5.40\text{e}14 \text{ MPN/year} \\ &= 1.75\text{e}12 \text{ WLA} + 5.38\text{e}14 \text{ LA} \end{aligned}$$

The TMDL is expressed as MPN/year because the loads are delivered in storm events and the criterion is expressed as a 30-day geometric mean. The federal TMDL regulations allow “appropriate measures” (40 CFR 130.2(l)) to be used to express TMDLs. MPN is the appropriate unit because it is the only unit of microbial indicators commonly measured. It is not possible to allocate storm-driven source loads using a daily time scale, since storm-driven nonpoint sources are episodic in nature.

Wasteload allocations for all point sources are combined into a single term based on current flows and concentrations (see Appendix A). Municipal dischargers are required

to disinfect effluent prior to discharge and to meet surface water quality criterion for fecal coliform in their effluent. Since the dischargers routinely achieve essentially complete disinfection (less than 20 MPN/100ml), the requirement to disinfect is effectively more stringent than the fecal coliform effluent criterion. For the purposes of the TMDL calculation, municipal effluent was therefore assumed to contain 20 MPN/100ml. Current rather than permitted flows were used because the effluent acts to dilute the fecal coliform in the stream; permitted flows would result in a non-conservative calculation under current flows. The total point source contribution is a fraction of a percent of the total load, and in reality acts to improve the water quality with respect to fecal coliform. Consequently, this fecal coliform TMDL will not impose any change in current practice for point sources and will not result in changes to existing effluent limits.

Evaluating annual load using a dynamic model made it possible to calculate the impact of episodic loads on 30-day geometric mean (Figures 1 and 3). The critical condition occurs when the intense rainfall over about 10 days following a dry period drives the 30-day geometric mean to its highest point.

Seasonal Variations

Seasonal variations are accounted for by basing the TMDL on the highest 30-day geometric mean that occurs during the year. By reducing the nonpoint source load enough to make the highest 30-day geometric mean compliant with the fecal coliform criterion, the 30-day geometric means throughout the rest of the year will be proportionately less than the criterion.

Margin of Safety

A number of conservative assumptions implicit in the TMDL calculation provide the Margin of Safety necessary to account for “lack of knowledge concerning the relationship between effluent limitations and water quality.” (40 CFR 130.7(c))

First, the choice of 1988 rainfall data provides a higher simulation of peak 30-day geometric mean compared to other rainfall years. 1988 total rainfall recurs every two years. Using drier rainfall years would reduce the fecal coliform, since it is rainfall that delivers virtually all the load. Using wetter rainfall years also reduces the simulated concentration of fecal coliform, since it is during the dry periods between storms that buildup occurs. Repeated rainfall events will provide dilution if there are not enough dry days for buildup to occur. 1988 rainfall included a very large 10 day storm event that was preceded by a long dry period. The subsequent peak 30-day mean drove the TMDL analysis and provided Margin of Safety.

Another conservative assumption was the use of current effluent flow from the municipal dischargers. Sewage treatment effluent is disinfected and contains extremely low bacterial counts. Permitted flows would provide more dilution and were not used to calculate the TMDL.

Finally, it is generally recognized that fecal contamination from stormwater poses much less risk of illness than fecal contamination from sewage or septic system effluent.¹² As Figure 2 shows, fecal coliform in the Whippany River is almost exclusively nonpoint source. Furthermore, most of the fecal coliform is flushed into the system during rainfall events and passes through the Whippany River in just a few hours. Bathing recreation is not a current use in the Whippany River, but bathing recreation in general occurs during dry periods.

Monitoring Plan

The Department will conduct follow-up monitoring through the Ambient Surface Water Monitoring Network program. In order to determine compliance with the pathogen indicator criteria, the Department samples each station in the network a minimum of 5 times in a 30-day period during the summer months of June to August. This sampling protocol is consistent with the Surface Water Quality Criteria for fecal coliform. At a minimum, the downstream station at Edward's Road that was used to calculate the fecal coliform TMDL will continue to be included in the Network and sampled annually accordingly. The Department fully expects that, after implementation of management measures to reduce nonpoint sources of fecal coliform, pathogen indicator levels will not exceed a geometric average of 200 MPN/100ml, nor will more than ten percent of the total samples taken during any 30-day period exceed 400 MPN/100ml.

Management Measures for Nonpoint Sources of Fecal Coliform

For each major nonpoint source category identified above, short-term management measures are identified below that will begin to reduce the source and/or the amount of fecal coliform discharged to the Whippany River. Unlike other pollutants that accumulate and persist in the environment after external sources have been removed, fecal coliform survives only a few days in the environment; therefore it is anticipated that the Whippany River will respond very quickly to reductions in fecal coliform sources. Additional measures will be required to verify and further reduce or eliminate each source of fecal coliform within the Whippany River Watershed in order to attain surface water quality standards.

Short-Term Management Measures

The following short-term measures either commenced in 1999 or will begin in early 2000 and will continue to be implemented throughout the next two years. These measures are aimed at reducing nonpoint source pollution in the Whippany River Watershed.

¹² Cabelli, V. 1989. *Swimming-associated illness and recreational water quality criteria*. Wat. Sci. Tech. 21:17.

- Proposed inter-municipal agreement by the Whippany River Watershed Action Committee that calls for the 16 watershed municipalities to recommend specific actions and programs to preserve, protect and maintain the land and water resources of the Whippany River Watershed.
- In 1999, the Whippany River Watershed Action Committee was notified of a Section 319 (h) NPS pass through grant award in the amount of \$17,5000 for restoration work in the watershed. Under this grant, the municipal Department of Public Works will implement BMPs for bacteria, phosphorus and sedimentation from nonpoint sources.
- In 1999, Hanover Township was notified of a Section 319 (h) NPS pass through grant award for \$50,000 to work with the Whippany River Watershed Action Committee to develop model ordinances for the 16 watershed municipalities to adopt in order to reduce nonpoint source pollution from stormwater runoff.
- In 1999, Hanover Township was notified of a federal 604(b) pass through grant grant in the amount of \$75,000 to conduct a diagnostic study of fecal impairment in the upper portions of the Whippany River Watershed.
- “A Cleaner Whippany River Watershed” nonpoint source pollution control guidance manual was accepted as a “living document” by the PAG at their December 7, 1999 meeting. It will be published in 2000 and formally presented at a workshop on May 11 and 12, 2000.

Whippany River Watershed Nonpoint Source Pollution Control Guidance Manual

Additional fecal coliform and phosphorus reductions will also be achieved through implementation of the Nonpoint Source Pollution Control Guidance Manual prepared by the Whippany NPS Workgroup entitled “A Cleaner Whippany River Watershed”. It was written to serve as a general guide to local officials in selecting appropriate BMPs that best address nonpoint source pollutants of concern in their municipality or subwatershed. The Guidance Manual will help the user through selecting specific source control measures that are pollutant specific as well as site specific. “A Cleaner Whippany River Watershed” is attached in Appendix G.

The Guidance Manual will be presented to local officials and township engineers in each of the 16 municipalities located within the Whippany River Watershed. The step-by-step approach promoted by the Guidance Manual, as well as the more common best management practices associated with land use, pre-development and/or redevelopment conditions throughout the watershed, will be presented in several workshops and field trips held throughout the 16 watershed municipalities. The Guidance Manual was distributed in January 2000 and subsequent workshops will be

held in May 2000 to present the document to the public. The Urban Conservation Action Partnership, a public/private partnership for natural resources conservation, is the recipient of an FY 2000 Section 319 (h) pass through grant to promote the Guidance Manual in order to "increase environmental literacy of public officials and consulting engineers, heads of departments of public works, landscape architects and planners". The grant project includes an evaluation component which will ascertain whether BMPs were implemented with regularity after attending these workshops.

The Guidance Manual identifies thirteen stormwater source control measures and provides a methodology that will assist the user in choosing a suitable BMP(s). The user of the Guidance Manual will also be able to determine which nonpoint source pollutant is most suitably addressed by the BMP and what percentage pollution concentration reduction may be expected from implementing and maintaining the BMP. In many cases, a specific BMP may reduce several nonpoint source pollutants but, with different degrees of effectiveness. The Guidance Manual proposes seven decision-making tables that will be useful in the selection of an appropriate BMP:

Stormwater Treatment Suitability: Determine if the BMP meets both the hydrology storage and water quality treatment requirements.

Community and Environmental Factors: Targets the potential BMP to determine if it has any important community or environmental benefits or drawbacks that might influence the selection process.

Site Feasibility Factors: Determines if there site limitations such as soils, drainage area, slope, and geology that might hinder or assist the effectiveness of implementing the BMP.

Cost and Maintenance Factors: Identifies relative cost of Best management practices (high, medium or low) along with its maintenance factors.

Most Appropriate Land Uses for Best Management Practices: Identifies the appropriateness of the BMP based on the one of five development categories.

Estimated Pollutant Reduction Capability for Best Management Practices: Where information was available, table identifies pollutant concentration reduction percentages derived from research, modeling and best professional judgement.

Permitting Considerations: Provides local and permitting guidance based on site features such as wetlands.

The Whippany River Watershed NPS Workgroup has endorsed the short-term management measures, including the Guidance Manual, which will be implemented at the municipal level through a combination of municipal ordinances, local agreements, education and outreach, and pass through grants. These measures, once

implemented, will begin to reduce fecal coliform levels within the Whippany River Watershed while longer term measures are being developed. The Whippany River Watershed Management Plan will also include these short-term measures and will promote these practices to ensure that they are implemented where practicable throughout the watershed.

Long-Term Management Strategies

While the short-term management measures will begin to reduce sources of fecal coliform in the Whippany River Watershed, additional measures will be needed to verify and further reduce or eliminate these sources. Some of these measures can be implemented now, where resources are available and sources have already been identified. Otherwise, specific watershed management strategies will be developed for each source identified below as part of the Watershed Management Area Plan for WMA 6. These strategies will be tailored to reduce each specific source's contribution of fecal coliform to the Whippany River Watershed. The strategies will all be designed to verify and assess these major source categories and to identify individual sources among them; develop specific measurable objectives; propose targeted management measures; identify measurable outcomes, deadlines, and responsible entities; and include monitoring and evaluation requirements to determine the success of the various management measures in achieving the strategies' objectives. These strategies will also address public involvement, operation and maintenance over time, and provide a cost-funding matrix.

The long-term management strategies will be developed collaboratively between the Department and the WMA 6 Public Advisory Committee, Technical Advisory Committee, Whippany Action Committee and Whippany Transition Team. The long-term strategies will be included in the WMA 6 Watershed Management Area Plan when it is developed.

Source Categories for Long-Term Management Strategies

Malfunctioning and Older Improperly Sized Septic Systems

Malfunctioning and older improperly designed septic systems contribute to fecal coliform loading in two ways: the system may fail hydraulically, where there is surface break out; or hydrogeologically, in which case the soils are inadequate to filter the pathogens. Specific management measures include:

- Conduct additional sanitary surveys and locate the systems using global positioning satellite system technology
- Implement results of the sanitary survey and diagnostic study resulting in a septic system management program

Canada Geese, Pest Waterfowl and other Wildlife

With the proliferation over the past 20 years of large corporate and recreational turf areas, the Canada goose resident population has exploded. Geese prefer to eat the low-fiber, high carbohydrate characteristics of mowed, fertilized turf. Consequently, parks, corporate lawns, and golf courses are subject to over browsing, shoreline erosion and excessive fecal matter near the water's edge. Specific management measures include:

- "No Feed Ordinances" for all waterfowl and wildlife
- Shoreline fencing and other barriers to eliminate access to grassed area along the waterways
- Habitat alteration; eliminate mowed turfgrass replace with buffer of tall grasses, shrubs and trees
- Overhead wire grids on ponds or lakes (outside of goose molting period) to restrict birds' access to the surface
- Hunting during established hunting seasons

Pet Waste

Pet waste contributes to fecal material and other nonpoint source pollutants such as nutrients. Bacterial levels in stormwater appear to be greater in residential areas than industrial or commercial zones. Thus the high concentration of pets associated with residential areas is a primary source of fecal contribution to stormwater. Specific management measures include:

- Adopt Pet Waste disposal ordinances for all 16 watershed municipalities
- Focus special attention to Patriot's Path along the Whippany River with signage and plastic bag dispensers
- Provide plastic bag dispensers in public recreation areas

Stormwater Basins

Stormwater detention/retention basins as well as wet storm ponds can act as accumulation points for fecal matter and other nonpoint source pollutants. A fast flush of runoff from a storm event detaches, mobilizes, and transports these substances directly to the nearest surface waters because of their design as flood control devices rather than as pollutant source control measures. Specific management measures include:

- Inventory stormwater basins and locate them using global positioning satellite system technology
- Conduct regularly scheduled stormwater basin cleanout programs
- Retrofit stormwater basins from flood control to nonpoint source control

Conclusion

With the implementation of short-term management strategies (to begin in 1999 and to be completed by 2002), long-term management strategies (to begin in 2004), and the Whippany River Watershed Nonpoint Source Pollution Control Guidance Manual, the Department has reasonable assurance that fecal coliform concentrations in the Whippany River will be brought into compliance with the Surface Water Quality Standards by 2005.